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(54) Abstract Title

Apparatus and method for gripping and releasing tubulars including a grip assurance mechanism

(57) An apparatus for gripping and releasing a tubular 33, 34 includes an elevator 13 and a spider 12, both having slips 15, 14 for gripping and releasing the tubular and a valve 18 for directly controlling a supply of pressurised fluid to move the spider slips 14 between a gripping and a release position. A grip assurance mechanism is provided to mechanically inhibit movement of the valve 18 such that the spider slips do not release the tubular if it is not being correctly gripped by the elevator. Preferably, the fluid supply control valve 18 is manually operated by a lever 22 which projects through a guide plate 24, the guide plate only being movable to allow the lever 22 to release the spider slips if the elevator slips are correctly gripping the tubular. A sensor is preferably provided to detect when the elevator slips are in the correct gripping position and this sensor may be a piston and cylinder arrangement 28 or a switch (51, figure 8). The sensor preferably controls a further piston/cylinder arrangement 31 coupled to a rod 32 which locks the guide plate 24 in the appropriate position.

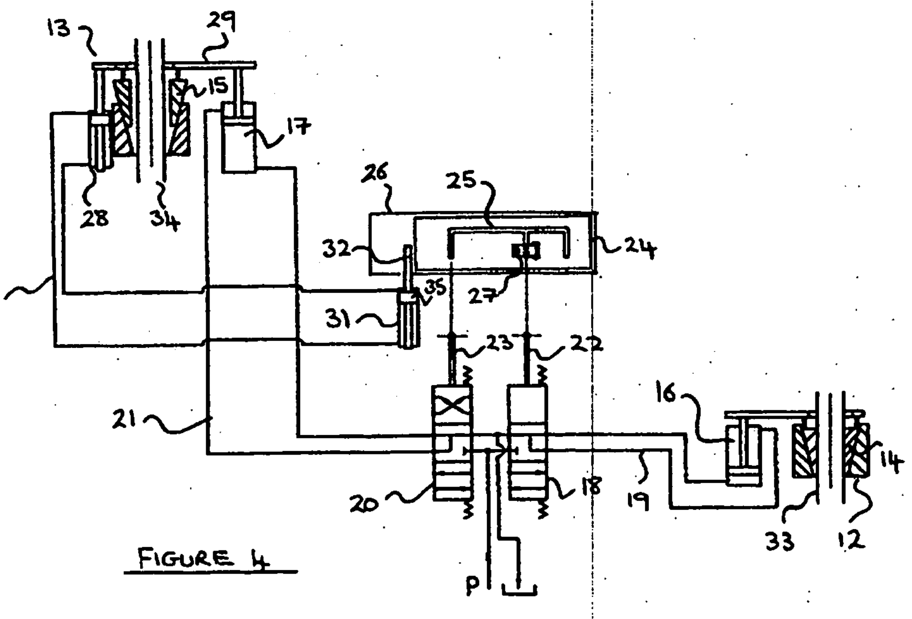

FIGURE 4

This print incorporates corrections made under Section 117(1) of the Patents Act 1977.

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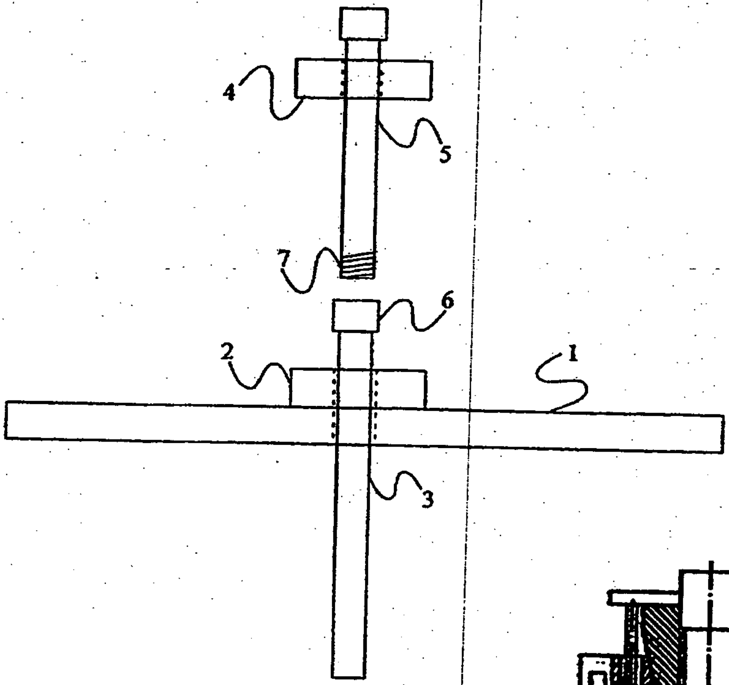

Figure 1

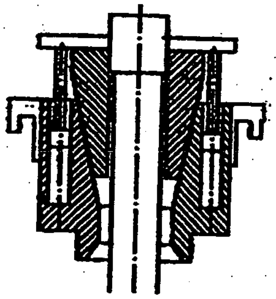

FIGURE 3

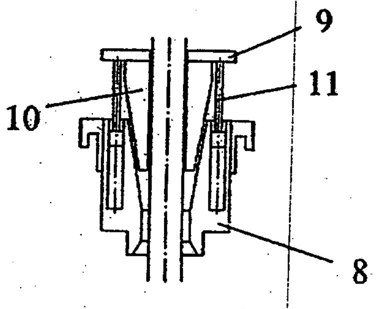

Figure 2

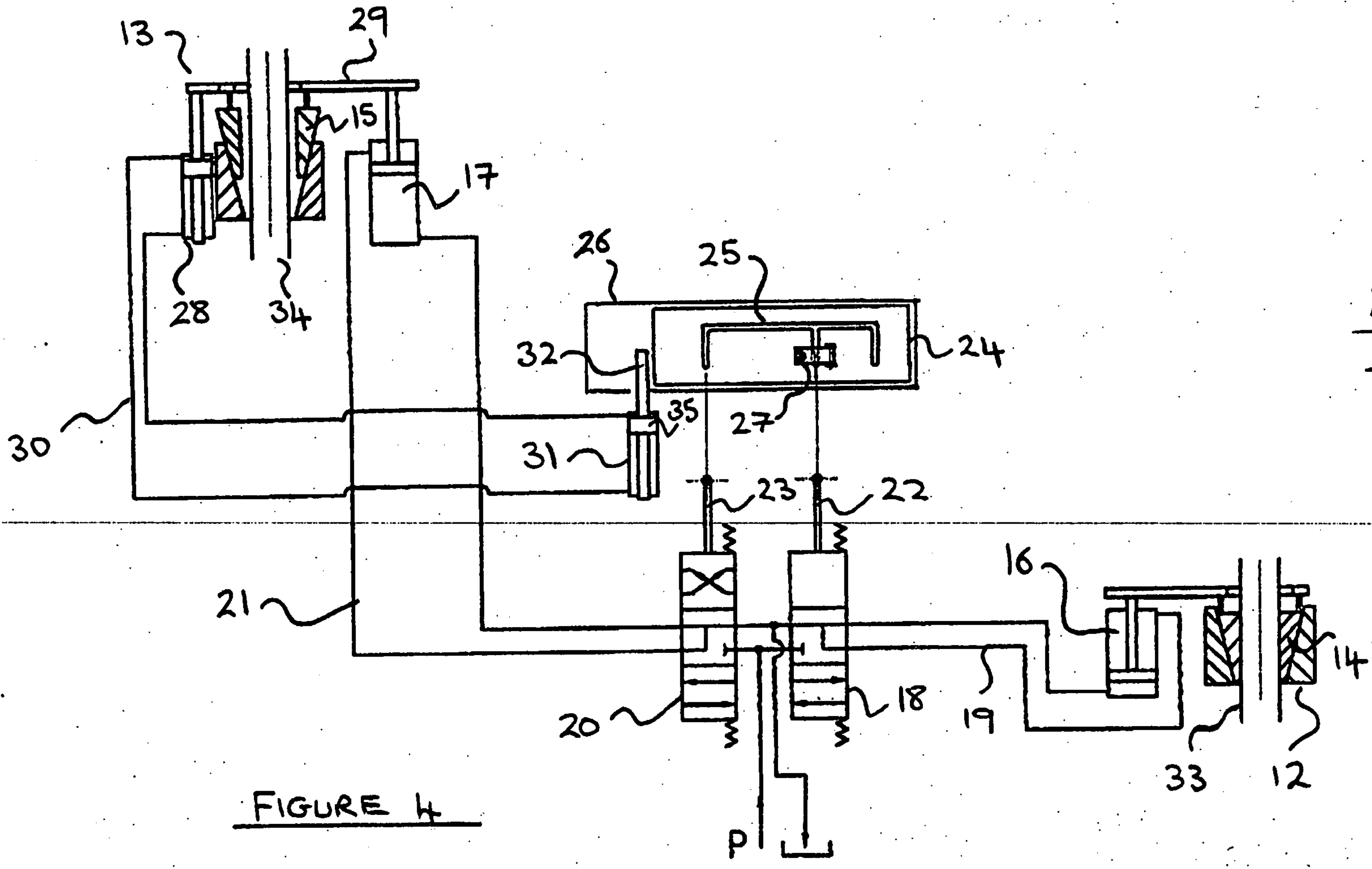

FIGURE 4

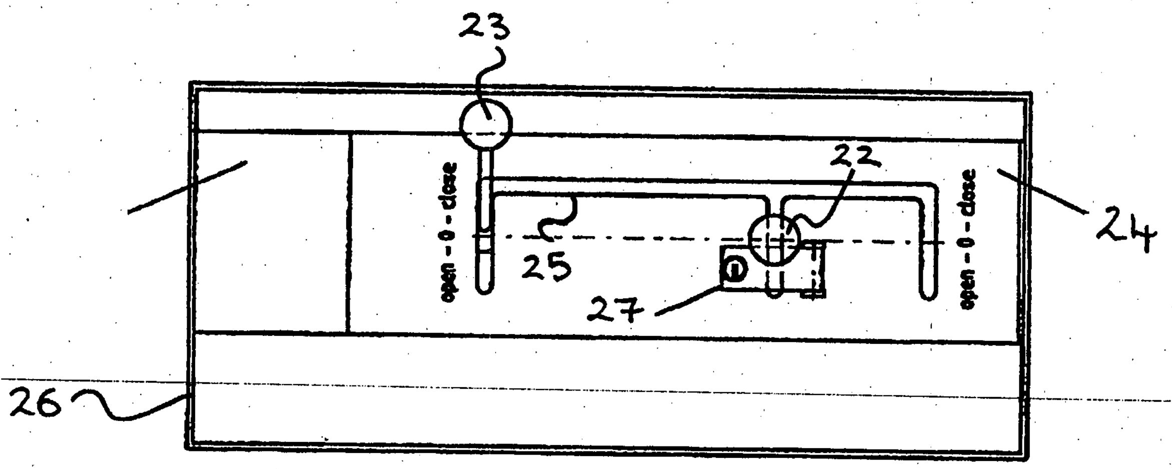

Figure 5

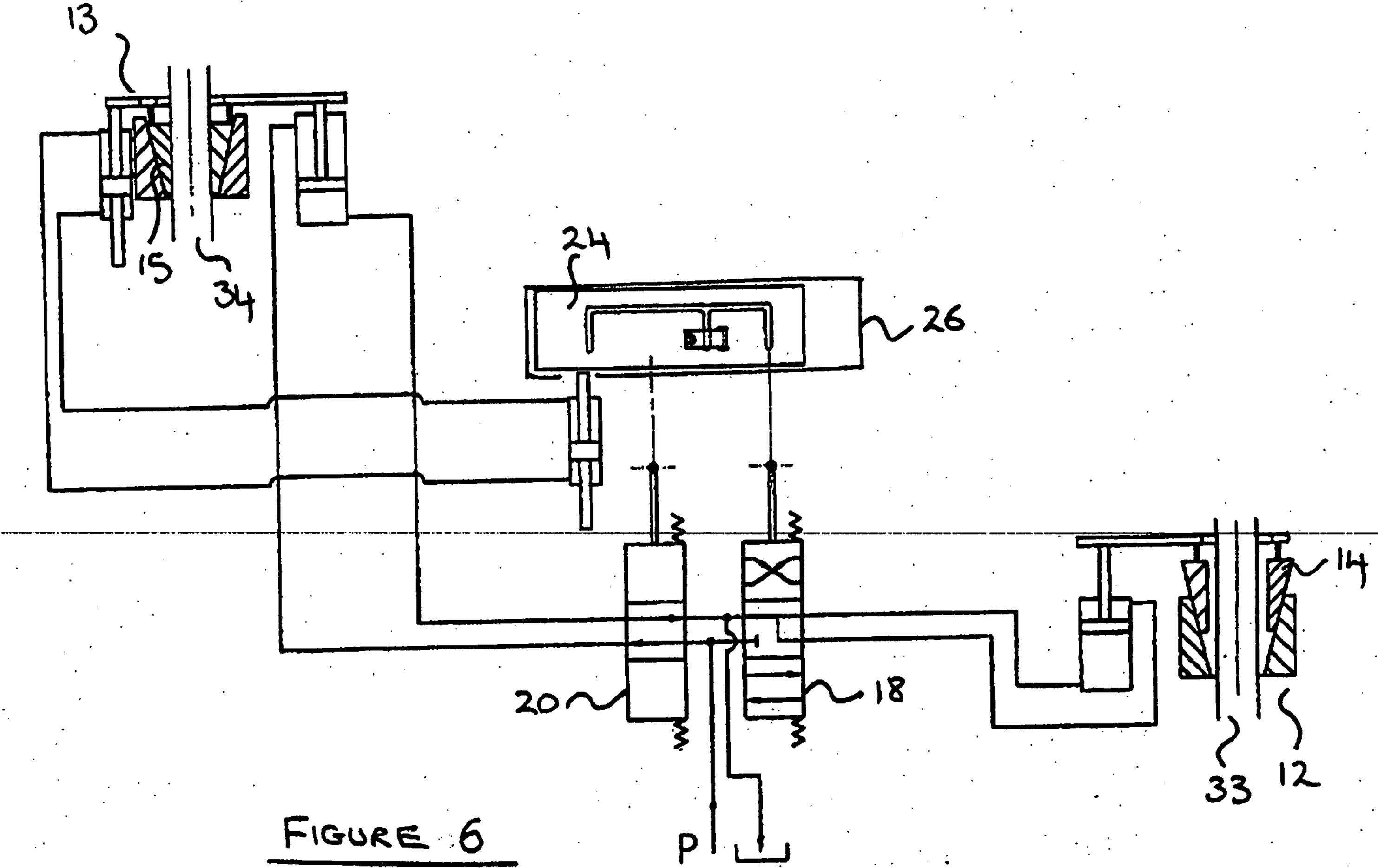

FIGURE 6

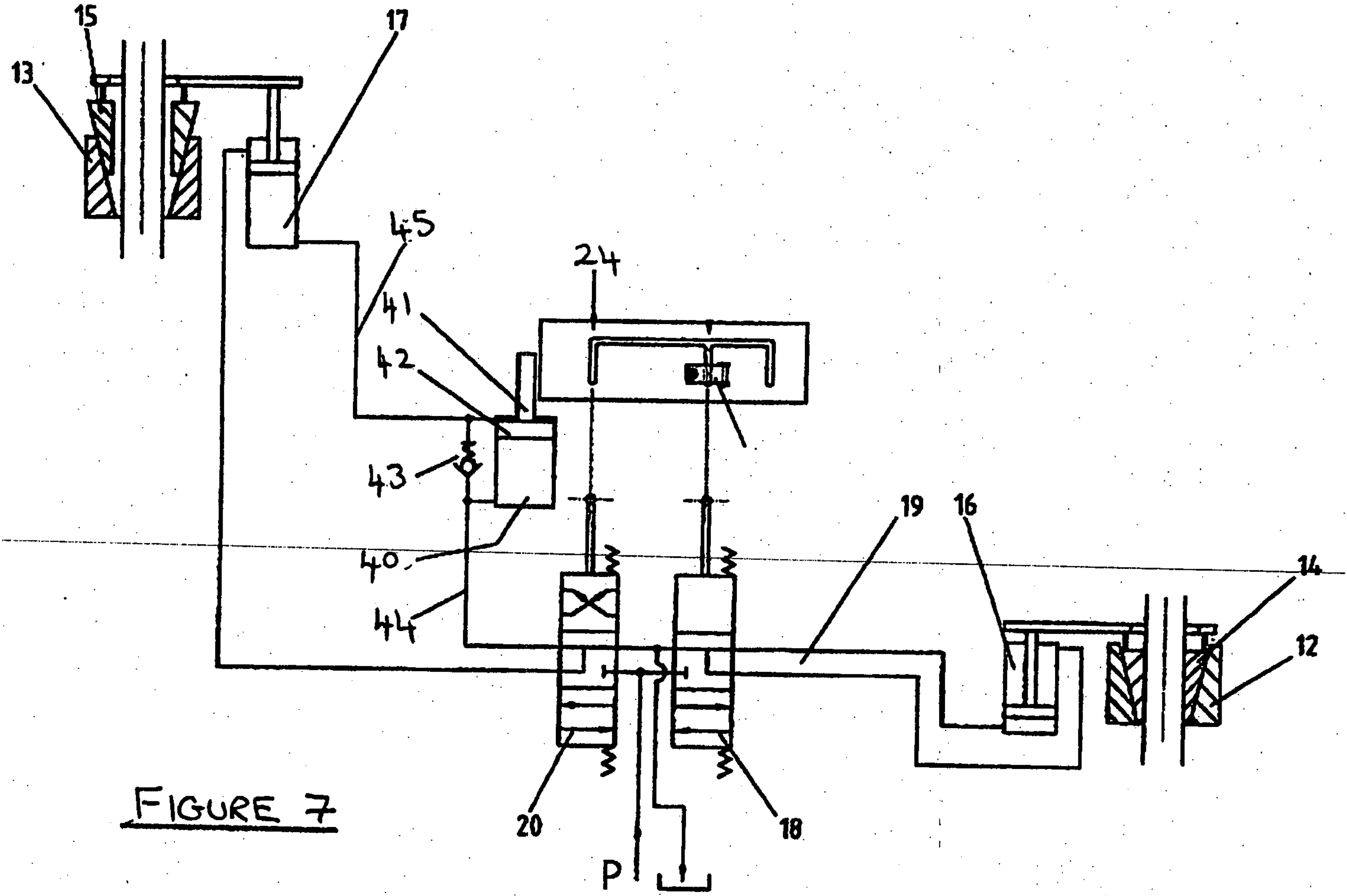

FIGURE 7

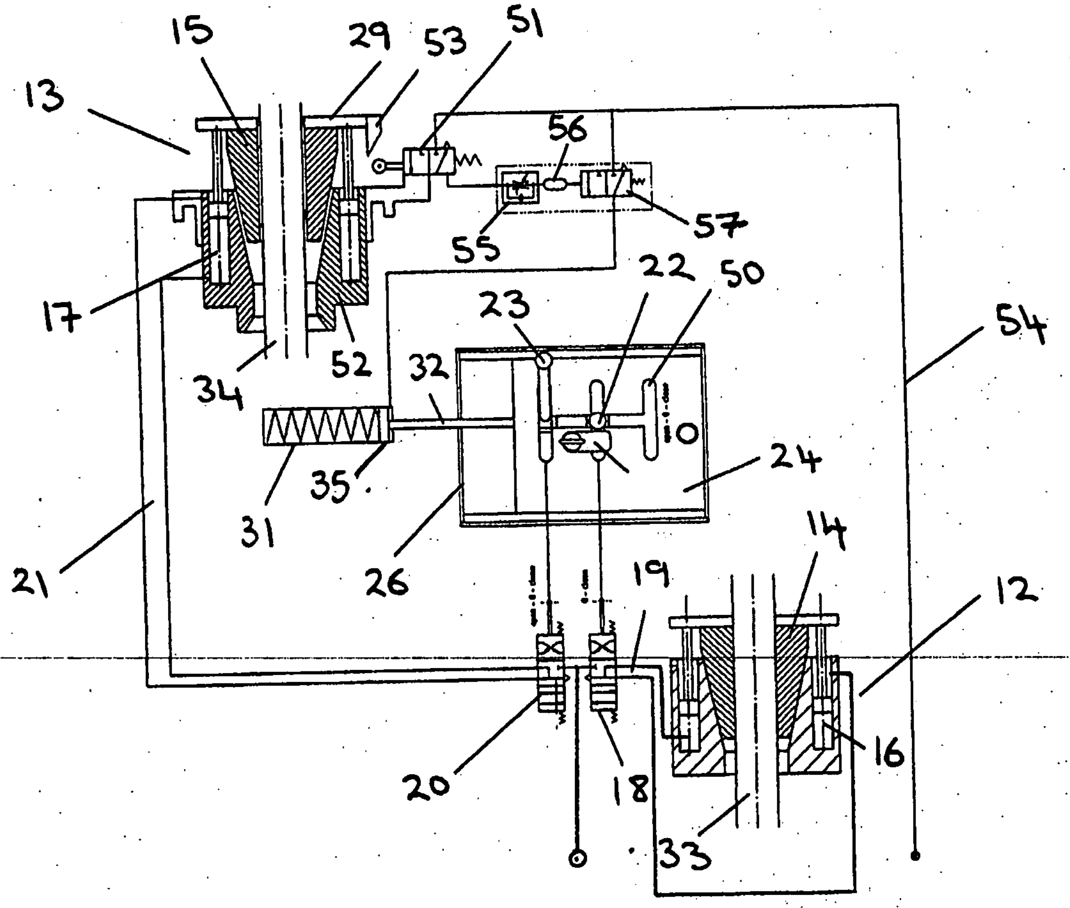

FIGURE 8

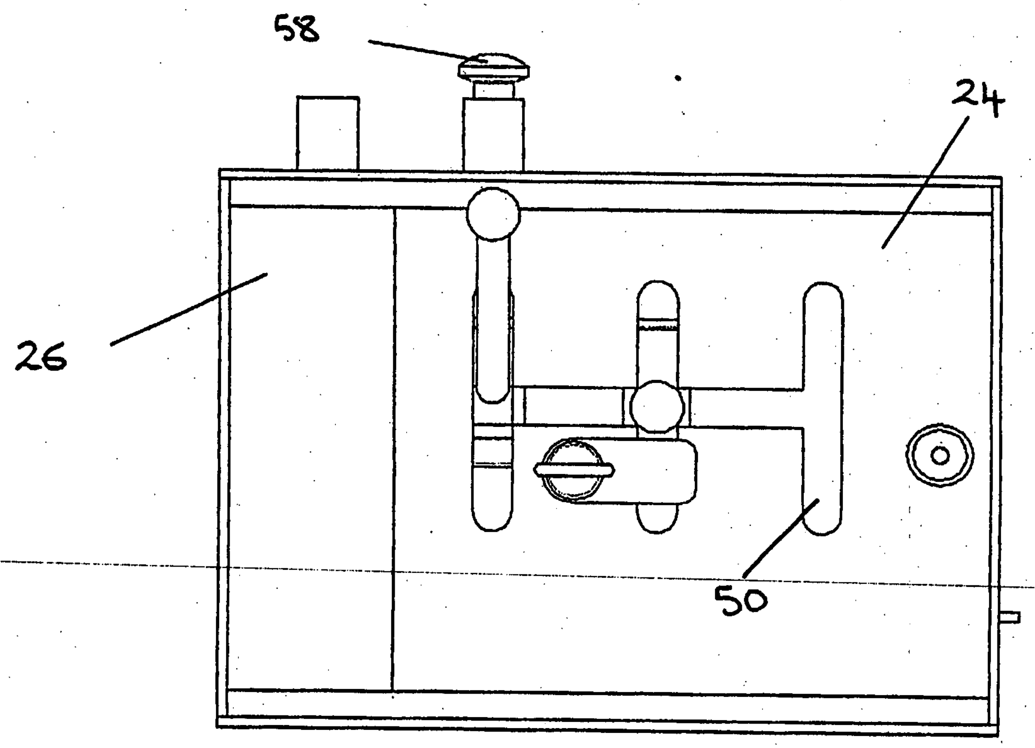

Figure9

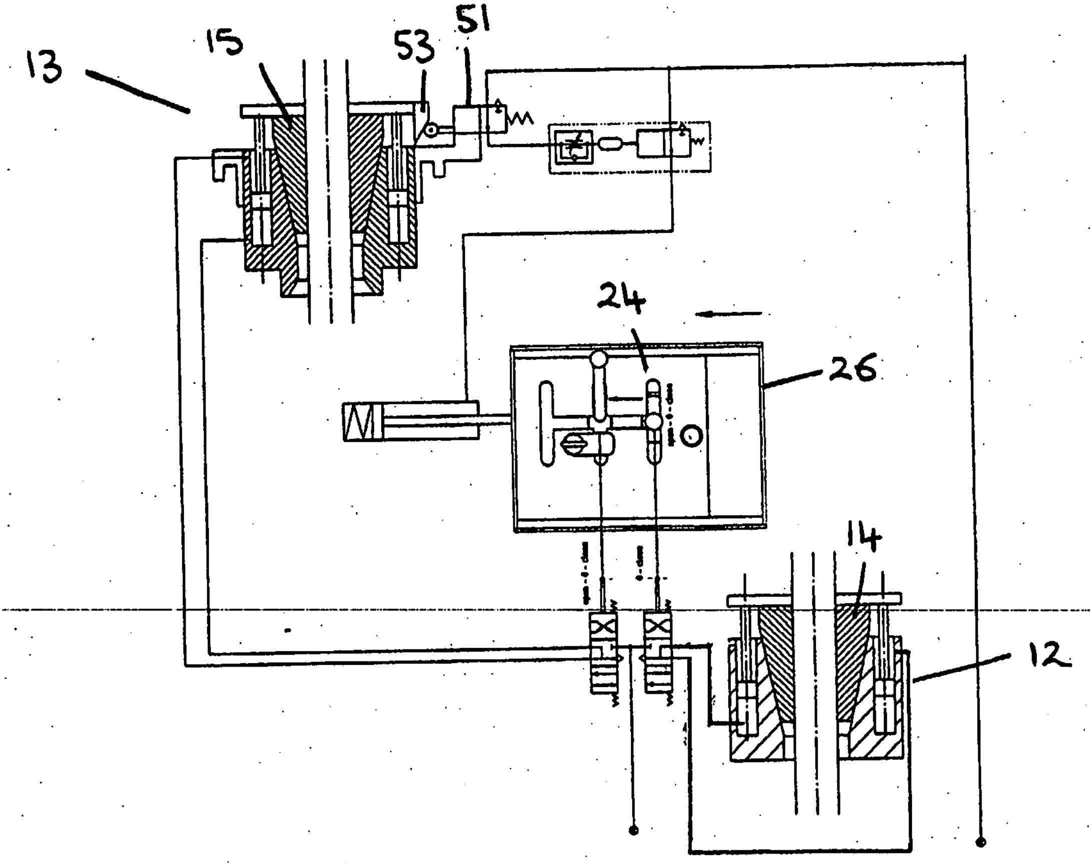

Figure 10

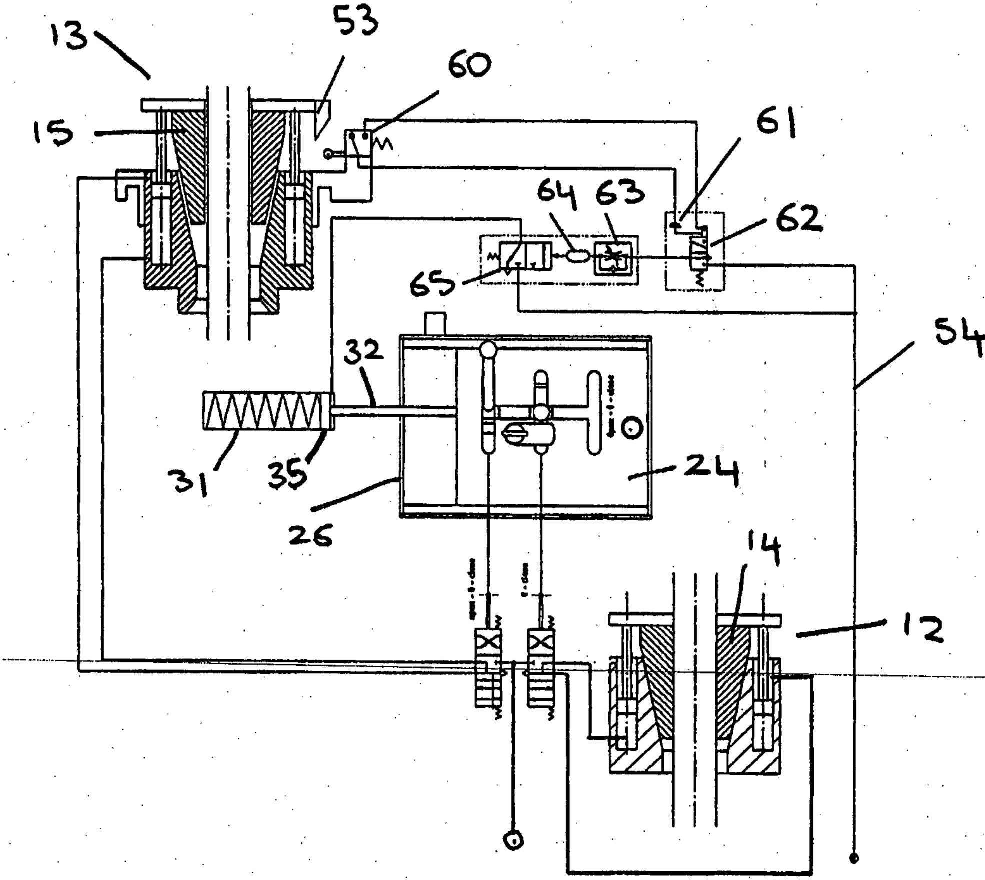

Figure 11

Method and Apparatus for Gripping Tubulars

The present invention relates to a method and apparatus for gripping tubulars, for example drill pipe. More particularly, the present invention relates to the provision in such a method and apparatus of a mechanism for avoiding the accidental release of tubulars during a handling operation.

During the construction and maintenance of oil wells it is necessary to construct extremely long strings of tubulars. For example, in order to drill a well a drill string is used, whilst after a well has been drilled a casing string must be constructed in order to line the well. Subsequently, a tubing for conveying oil to the surface is inserted inside the casing. Due to the great weight of such tubular strings, possibly several hundred tons, extreme care is required when constructing, raising, and lowering the strings.

Figure 1 illustrates in schematic form a typical tubular handling system which is mounted on the surface of an oil drilling platform 1. Mounted in the platform itself is a spider 2 for gripping a tubular 3 extending beneath the platform 1 into a well. The spider 2 may be mounted within a rotary table, for example where the string 3 is a drill string. Suspended above the platform 1 is an elevator 4 which is arranged to grasp individual lengths of tubular 5 which are to be attached to the string 3, or alternatively which have just been removed from the string 3. The elevator 5 must also take the full weight of the string 3 during the raising or lowering of the string 3 through the spider 2 (and immediately following the addition or removal of a length of tubular from the string). Both the spider 2 and the elevator 5 must be able to take the full weight of the string 3.

A typical sequence of events during the making up of a string is as follows:

the spider grips the existing string;

a new length of tubular is removed from a storage rack and is gripped in a vertical orientation by the elevator;

the elevator is moved to position the lower pin 7 of the new length above the upper box 6 of the string projecting from the spider - and the opposed pin and box are engaged;

the grip of the elevator is released, and the new length is engaged by a power tong and spinner and the joint tightened;

the elevator again grips the string and is raised slightly to take the weight of the string, and the spider releases the string;

the string is lowered by the elevator through the spider by the height of one length of tubular;

the string is once again gripped by the spider, and the elevator released to collect a further length of tubular.

The basic construction of the spider 2 and the elevator 5 is the same and is illustrated in a cross-section in Figure 2. A hollow cylindrical structure 8 has an inner wall which slopes outwardly towards its upper opening. A member 9 supports a set of slips (for example three) 10 which are shaped to slide into the upper opening of the structure 8 and at to engage the sloping inner sidewalls of the structure 8. The slips 10 are free to move radially to a limited extend. Each slip 10 can be raised and lowered relative to the structure 8 by a pneumatically or hydraulically driven piston 11 which engages a cylinder extending into the structure 8. It will be understood that when the slips 10 are in the lowered position, they will engage the outer surface of a tubular passing through the centre of the apparatus. The weight of the tubular and the friction between the tubular and the slips 10 will force the slips 10 downward and inward (as a result of the reaction force between the slips 10 and the inner surface of the structure 8). Thus the grip tightens on the tubular 5.

The hydraulic or pneumatic power which can be applied to the pistons which move the slips is limited. The resulting force is not sufficient to raise the slips of an elevator or spider when that elevator or spider is taking the weight of any significant length of tubular. In theory at least it is not possible for an operator to release the slips of the elevator and the spider at the same time, an action which would result in the dropping of the tubular into the well.

A potential problem with the slip design described however is that it is possible, when the new length of casing has been attached to the string and the elevator regrips the tubular, for the elevator to grip the tubular at too high a point such that the slips contact the tubular at the junction between the outstanding box and the main body of the tubular. Thus, the only contact between the slips and the tubular may be over a small part of the length of the slips. This situation is illustrated in Figure 3. The elevator may be able temporarily to hold a sufficient proportion of the full tubing string weight to allow the spider slips to be released. However, following the raising of the spider slips, the elevator may not be able to take the full weight of the string with the string being dropped into the well.

A possible solution to the problem has been disclosed in US4,676,312. This document describes an interlock circuit in which the supply of pressurised air to the valve which controls the movement of the spider slips is prevented by an interlock valve if the elevator slips are not correctly engaged with the tubing.

According to a first aspect of the present invention there is provided apparatus for gripping and releasing a tubular, the apparatus comprising:

an elevator having slips for gripping and releasing the tubular;

a spider having slips for gripping and releasing the tubular;

a valve for directly controlling the supply of pressurised fluid to move the spider slips between a gripping position and a release position; and

means for mechanically inhibiting movement of said valve to a position in which the spider slips release the tubular when the elevator slips are not in a gripping position.

As used here, the term "elevator" means apparatus which is arranged to grip and hold a tubular for the purpose of raising and lowering the tubular. The term "spider" means an apparatus arranged to grip and hold a tubular whilst remaining substantially stationary.

Embodiments of the present invention may significantly reduce the risk of a tubular being dropped into the well as a result of the elevator slips not properly engaging the uppermost length of a tubing string. The movement of the valve controlling the opening of the spider slips is mechanically inhibited if the elevator slips are not correctly engaging the tubular.

Preferably, said valve for directly controlling the supply of pressurised fluid to move the spider slips is a mechanically operated valve which is operated manually. Alternatively however, the valve may be operated by an electrical motor, solenoid, etc, and/or may be remote controlled (e.g. using radio, infra-red, or ultrasonic signals).

In certain embodiments of the present invention, the valve for controlling the supply of pressurised fluid to the spider slips is operated by a lever. The means for mechanically inhibiting movement of the valve comprises a guide plate through which the lever projects. The guide plate is moveable between first and second positions. In a first position the guide plate prevents movement of the lever to open the valve and in a second position allows movement of the lever to open the valve. Movement of the guide from the first position to the second position is prevented if the elevator slips are not correctly closed.

In certain embodiments of the present invention, the apparatus comprises sensor means for detecting when the elevator slips are in the correct gripping position. The sensor means is coupled to said means for mechanically inhibiting movement of the spider control valve.

In certain embodiments of the invention, the sensor means comprises a piston and cylinder arrangement coupled between the main body and the slips of the elevator. The piston and cylinder arrangement is coupled hydraulically to said means for mechanically inhibiting movement of the spider control valve.

In other embodiments of the present invention, said sensor means comprises a switch which is moved from a first position to a second position when the elevator slips are moved to the correct closed position. When the switch is in the first position, movement of the guide plate from its first to its second position is prevented. When the switch is in the second position, movement of the guide plate from its first to its second position is possible. More preferably, the switch controls the supply of pressurised fluid to a piston and cylinder arrangement, the piston of which locks the guide plate in its first position when the supply of pressurised fluid to the cylinder is prevented, and releases the guide plate when the supply of pressurised fluid to the cylinder is allowed. Preferably, said switch is arranged to directly open and close a hydraulic or pneumatic circuit. Alternatively, the switch may form part of an electrical circuit which is arranged to open and close a hydraulic or pneumatic circuit.

The means for mechanically inhibiting movement of the spider control valve may comprise a piston and cylinder arrangement of a hydraulic or pneumatic circuit coupling an elevator control valve to a piston and cylinder arrangement for opening and closing the elevator slips. The first mentioned piston and cylinder arrangement is located between the piston and cylinder arrangement for moving the slips and the elevator control valve. A rod of the first mentioned piston and cylinder arrangement is displaced by the flow of fluid in the circuit to inhibit or allow movement of the spider control valve.

Other arrangements for locking and unlocking the guide plate are envisaged. The sensor may be an optical of electrical switch which detects closure of the elevator slips. The switch may control the supply of pressurised fluid (pneumatic or hydraulic) to a guide plate locking means.

The apparatus may comprise a mechanical link coupling the elevator slips to the means for mechanically inhibiting movement of the spider control valve. For example, the link may be a Bauden cable where movement of the elevator slips causes a corresponding movement of the core of the cable which is connected to the means for inhibiting movement of the spider control valve.

It will be appreciated that the apparatus may also comprise a mechanically operated valve for controlling the supply of pressurised fluid to move the elevator slips between a gripping position and a release position. This valve may be operated by a lever which also projects through said guide plate. Preferably, when the guide plate is in its first position, the lever may be moved to open the elevator slips, whilst when the guide plate is in its second position, movement of the lever to open the slips is prevented.

In alternative embodiments of the invention, the mechanically operated valve for controlling the supply of pressurised fluid to move the spider slips between a gripping position and a release position may be operated by a switch, knob, or the like, with movement of the knob, switch, etc being inhibited to prevent the valve being operated to open the spider slips when the elevator slips are not correctly closed.

An additional user operable locking means may be provided for preventing accidental movement of the guide plate between the first and second positions.

According to a second aspect of the present invention there is provided a method of controlling the gripping and releasing of a tubular and comprising mechanically inhibiting movement of control means for directly controlling the flow of fluid to raise and lower a set of spider slips, when a set of slips of an elevator are not correctly gripping the tubular, such that the spider slips cannot be moved from a gripping to a release position.

Preferably said control means is a valve. However, the control means may be any other suitable apparatus such as a pump.

According to a third aspect of the present invention there is provided a method of gripping and releasing a tubular, the method comprising the steps of:

gripping the tubular with a spider;

actuating a set of slips of an elevator in order to move the slips from a position in which the tubular is not gripped by the slips to a position in which the tubular is gripped by the spider;

in the event that actuation of the elevator slips does not cause the slips to move into the gripping position, mechanically inhibiting movement of a valve directly controlling the movement of a set of spider slips such that the spider slips cannot be moved from a gripping to a release position; and

in the event that the elevator slips achieve the correct gripping position, allowing said valve to be operated to move the spider slips from the gripping to the release position.

For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made by way of example to the accompanying drawings, in which:

Figure 1 illustrates schematically an elevator and spider arrangement for handling tubulars;

Figure 2 illustrates in more detail the structure of an elevator/spider of the arrangement of Figure 1;

Figure 3 illustrates a scenario where the elevator slips are not correctly gripping a tubing;

Figure 4 illustrates schematically a system for controlling the elevator and spider of the arrangement of Figure 1;

Figure 5 illustrates in detail a valve control mechanism of the system of Figure 4;

Figure 6 illustrates the control system of Figure 4 in a second operational configuration;

Figure 7 illustrates schematically a modified system for controlling the elevator and spider of the arrangement of Figure 1;

Figure 8 illustrates an alternative system for controlling the elevator and spider of the arrangement of Figure 1;

Figure 9 illustrates in detail a valve control mechanism of the system of Figure 8;

Figure 10 illustrates the control system of Figure 8 in a second operational configuration; and

Figure 11 illustrates schematically a further modified system for controlling the elevator and spider of the arrangement of Figure 1.

A conventional system for handling tubulars using an elevator and spider arrangement has been described above with reference to Figures 1 to 3. There will now be described a control system for controlling the operation of such a spider and elevator arrangement in order to reduce the risk of a tubular being dropped down a well. The following discussion concerns the making or breaking of a drill pipe string although the apparatus and control system can equally be used with a well casing or tubing.

With reference to Figure 4, there is illustrated a spider 12 having a set of slips 14, and an elevator 13 having a set of slips 15. The spider and elevator each have a construction which is similar to that illustrated in Figure 2. More particularly, the slips 14, 15 of the spider 12 and elevator 13 are raised and lowered by respective hydraulically operated piston and cylinder arrangements 16, 17 (only one piston cylinder arrangement is shown in Figure 4 for each of the elevator and spider). Pressurised fluid is supplied to the piston arrangement 16 of the spider 12 via a spider control valve 18 and supply lines 19. Similarly, Pressurised fluid is supplied to the piston and cylinder arrangement 17 of the elevator 13 via an elevator control valve 20 and supply lines 21.

Both the spider control valve 18 and the elevator control valve 20 are operated by respective levers 22,23. In order to close a set of slips 14,15 which are currently in the release position, the lever of the corresponding control valve is moved for a short time (e.g. a few seconds) to a "close" position. After the slips have been moved, the lever is returned to a central "neutral" position. Similarly, in order to open a set of slips 14,15 currently in a closed position, the corresponding lever is moved for a short time to an "open" position before being returned to the central neutral position. Each lever 22, 23 therefore has three positions; open, close, neutral. In the arrangement shown in Figure 4, the close position for the control valves 18,20 is the uppermost position of the respective levers 22,23, whilst the open position is the lowermost position of the levers. The neutral position lies in the centre.

In order to control the operation of the levers 22, 23, the control valves 18,20 are mounted directly beneath a guide plate 24 (in the schematic illustration of Figure 4, the control valves 18,20 and levers 22,23 are shown displaced from the guide plate 24 for the sake of clarity). The guide plate 24 has a series of slots 25 machined into it. The slots 25 define the various positions to which a lever 22, 23 can be moved during certain stages of a pipe handling process. The guide plate 24 is slidably mounted within a box 26 which contains the spider and elevator control valves 18, 20. The guide plate 24 can be slid between a first rightmost position to a second leftmost position, providing that both levers 22,23 are in the close positions (and that the guide plate 24 is not otherwise locked - see below).

In the first operational position, the elevator control valve lever 23 can be moved from the neutral position to both the open and close positions, whilst the spider control valve lever 22 may be moved between the neutral and the close position. In the second operational position of the guide plate 24, the elevator control valve lever 23 must remain in the close position, whilst the spider control valve lever 22 may be moved from the neutral position to both the open and close positions. Figure 5 illustrates the guide plate arrangement in more detail.

With reference again to Figure 4, an auxiliary hydraulically operated piston and cylinder arrangement 28 is shown coupled to the annular ring 29 on which the elevator slips 15 are mounted. The arrangement 28 does not play an active part in raising and lowering the slips 15, but rather acts as a passive slip position sensor. The position of the piston within the cylinder tracks the position of the elevator slips 15. The arrangement 15 is coupled via hydraulic fluid supply lines 30 to a guide plate locking mechanism 31. This mechanism comprises a further piston and cylinder arrangement. A rod 32 coupled to the piston 35 of the mechanism 31 is arranged to engage the guide plate 24 when the piston 35 is fully extended, locking the guide plate 24 in its rightmost position. However, when the piston 35 is withdrawn, the rod 32 disengages the guide plate 24 allowing the guide plate to move freely between its leftmost and rightmost positions (subject to the position of the levers 22,23).

Figure 5 illustrates a lock 27 which blocks a slot which, when unblocked, allows the movement of the spider control valve lever 22 to the open position - in exceptional circumstances, when it is required to open the spider slips 14 and the elevator slips 15 at the same time, this lock 27 may be manually removed.

The operation of the control system of Figure 4 will now be described, assuming that the system has previously been operated such that the slips of the spider 12 are gripping a lower portion of a drill string 33 whilst the slips 15 of the elevator 13 are in the raised or open position relative to an upper length of drill pipe 34. Assume now that the upper length 34 has been attached to the lower drill pipe string 33 and that the joint has been sufficiently tightened. In order to allow the drill string 33 to be lowered through the spider 12 such that a further length of drill pipe may be attached to the top of the string 33, the slips 14 of the elevator 13 must be closed to allow the elevator 13 to take the full weight of the drill string 39 when the spider slips 14 are raised. The guide plate 24 is currently in the rightmost position such that the lever 23 of the elevator control valve 20 can be moved from the neutral position to either the open or close position. The lever 23 is moved by the operator to the close position and the control valve 20 opened to supply pressurised fluid to the top of the piston cylinder arrangement 17. The application of pressurised fluid results in the slips being lowered into the elevator 13.

The position of the piston within the arrangement 28 tracks the position of the elevator slips 15 relative to the elevator body. Movement of the piston within the cylinder causes fluid to be expelled from the cylinder, through the supply lines 30 into the top of the cylinder of the arrangement 31. This causes the piston 35 to be withdrawn into the cylinder, moving the locking rod 32 away from the guide plate 24. When the elevator slips 15 have been lowered to the correct position in which they engage the body of the pipe length 34, the rod 32 is disengaged from the guide plate 24. In this position, the guide plate 24 can be moved by the operator to the left providing that both levers 22,23 are held in the close position. The lever 22 can then be operated to open the spider slips 14. This configuration is illustrated in Figure 6.

In the event that the operator moves the elevator control valve lever 23 to the close position whilst the elevator 13 is located at too high a position with respect to the upper length of drill pipe length 34, it is possible that the elevator slips 15 may close around the junction between the upper box of the pipe and the main body of the pipe (the situation illustrated in Figure 3). If this happens, then the grip achieved by the elevator 13 on the pipe length 34 is not necessarily sufficient to take the full weight of the drill pipe string 33. The grip achieved might be sufficient to take enough of the weight to allow the spider slips 14 to be raised. As has already been described, this situation can result in the subsequent dropping of the string into the well. However, it will be appreciated that if the elevator slips 15 close about the box of the pipe length 34, then the slips 15 will not be able to move to their correct lower position relative to the elevator body. Rather, the slips 15 will become "jammed" at some intermediate position.

If this situation arises, the piston of the sensor arrangement 28 will not be sufficiently withdrawn into the cylinder. The volume of fluid transferred to the arrangement 31 will not be sufficient to fully disengage the rod 32 from the guide plate 24. It will not therefore be possible for an operator to move the guide plate 24 to the left, and to open the spider slips 14. This embodiment of the present invention therefore provides a mechanical "sequencer" for the spider and elevator control valves 18,20.

Figure 7 illustrates an alternative control system for ensuring that the spider slips 14 cannot be opened when the elevator slips 15 are not correctly gripping the drill string. Components common to the system of Figure 4 have been identified using the same reference numerals. A piston and cylinder arrangement 40 has a rod 41 coupled to its piston 42. This rod 41 provides the locking mechanism for the guide plate 24. The arrangement 40 is located within the fluid circuit 44,45 coupling the control valve 20 to the arrangement 17 which raises and lowers the elevator slips 15. A one way valve 43 is connected in parallel with the arrangement 40. When the elevator slips 15 are lowered, fluid is expelled from the cylinder(s) of the arrangement 17. This fluid drives the piston 41 into its cylinder (no fluid can flow through the valve 43), causing the rod 41 to disengage from the guide plate 24. Assuming that the elevator slips 15 are lowered to the correct position, the guide plate 24 is free to move to the left. Of course if the slips are not lowered correctly, then the guide plate 24 is prevented from moving by the rod 41.

When the valve 20 is subsequently operated to raise the elevator slips 15 (following the opening and closing of the spider slips 14), pressurised fluid drives the piston 42 out of its chamber. The pressurised fluid expelled from the chamber is in turn forced into the chamber(s) of the elevator slip drive arrangements 17, causing the elevator slips 15 to be raised. The valve 43 is provided to compensate for leaks, and ensures that sufficient fluid is available to fully open the elevator slips 15 when required.

Figure 8 illustrates another control system according to the present invention. Again, reference numerals used in Figure 4 have been reused to identify common parts. It is noted that the embodiment of Figure 8 uses a guide plate 24 having a different arrangement of guide slots 50. This arrangement allows the guide plate 24 to be shifted only when both levers 22,23 are in the neutral position (and movement is not prevented by the locking rod 32). The guide plate 24 is shown in more detail in Figure 9.

With reference to Figure 8, a mechanically operated valve switch 51 is rigidly attached to the main body 52 of the elevator 13. The valve switch 51 forms part of a pneumatic control circuit. A contact member 53 is attached to the upper annular ring 29 which supports the slips 15. When the spider slips 15 are in the raised position, i.e. the spider is in the release position, the contact member 53 is not in contact with the valve switch 51. In this position, the valve switch 51 remains closed and does not pass compressed air from its input to an output. However, when the spider slips 15 are in the correct lowered position, and the spider 13 is in the gripping position, the contact member 53 contacts the valve switch 51, causing the switch to open and compressed air to be supplied from the input of the valve switch 51 to its output.

Pressurised fluid is supplied to the input of the valve switch 51 via a supply line 54 (which is coupled to a pressurised source of fluid which is not shown in the drawing). The output of the valve switch 51 is provided to the input of a delay circuit. This circuit comprises a one way flow regulator 55 which allows the compressed air from the output of the valve switch 51 to be fed to the input of an accumulator 56. The output of the accumulator 56 is provided to a control input of a second valve switch 57. The main input of the second valve switch 57 is coupled to the supply line 54. The output of the second valve switch 57 is provided to an input of the piston and cylinder arrangement 31, which input is situated in front of the head of the piston 35.

In the event that the elevator slips 15 close about the main body of the drill pipe 34, the slips 15 will be lowered relative to the elevator 13 to the required extent. The contact member 53 will contact the valve switch 51, causing the switch to open. Compressed air will flow from the supply line 54, through the flow regulator 55 to the input of the accumulator 56. Pressure builds up in the accumulator 56 until the pressure at the output of the accumulator 56 causes the second valve switch 57 to open. The time taken for the accumulator 56 to charge to a sufficient pressure to activate the second valve switch provides a short time delay between the closure of the elevator slips 15 and the possible release of the guide plate 24. As long as the second valve switch 57 remains closed, no pressure is present at the head of the piston 35 and the piston remains in its fully extended position in which the guide plate 24 is locked in its rightmost position. However, when the second valve switch 57 is opened, compressed air from the supply line 54 is conducted to the head of the piston 35 causing the piston to be retracted within its cylinder. The retraction of the piston 35 causes the guide plate 24 to be released. Assuming therefore that the operation of the lever 23 has resulted in the elevator slips 15 being moved to their correct lowered or closed position, the operator can slide the guide plate 24 to its leftmost position. The operator can then operate the lever 22 of the spider control valve 18 to move the spider slips 14 to their raised or open position. The elevator 13 then takes the full weight of the drill pipe string 33. This configuration is illustrated in Figure 10.

In the event that the elevator slips 15 grip around the box of the drill pipe 34, the contact member 53 attached to the slip support ring 29 will not contact and open the valve switch 51. Thus, no pressure will be applied to the head of the piston 35 and the guide plate 24 will remain locked in its rightmost position. In this position, the lever 22 operating the spider control valve 18 cannot be moved from its neutral position to open the spider slips.

Figure 9 illustrates a manually operable locking mechanism 58 which is mounted in the box 26 supporting the guide plate 24. The locking mechanism 58 is of a type which when pulled out allows movement of the guide plate 24 from the left to the right and *vice versa* whilst when pushed in prevents such movement of the guide plate 24. In order to move the guide plate 24 from the right to the left position, in addition to the piston 35 being fully withdrawn into the cylinder 29, the operator must pull out the locking mechanism 58 (against a spring force) and at the same time slide the guide plate 24 from the right to the left. When the operator releases the mechanism 58, the guide plate cannot be shifted to the right unless the operator again pulls out the mechanism 58. The locking mechanism 58 therefore provides an obstacle to an operator moving the guide plate 24 to the left, opening the spider slips, and then sliding the guide plate to the right and opening the elevator slips (this could of course only happen in the case that a small length of drill pipe is being held by the spider elevator arrangement).

Figure 11 illustrates a further control system for controlling an elevator and spider arrangement such as has been described with reference to Figures 1 to 3. In this arrangement, the contact member 53, coupled to the elevator slips 15, is arranged to open and close an electrical switch 60. The electrical switch 60 forms part of a circuit comprising a battery 61 and an electrically controlled valve 62. When the elevator slips 15 are in the raised position, the contact member 53 is out of contact with the switch 60, and the switch 60 is in the open position. The electrical circuit comprising the switch 60 therefore remains open and no electric power is supplied to the control input of the valve 62. However, when the elevator slips 15 are correctly lowered, the contact member 53 closes the switch 60 such that the battery 61 is coupled to the control input of the valve 62. This supply of power to the valve input causes the valve to close, connecting the supply line 54 to the input of a delay circuit having at its input a one way flow regulator 63. As with the embodiment described with reference to Figure 8, the output from the flow regulator 63 is provided to the input of an accumulator 64.

When the pressure in the accumulator 64 reaches a predefined level, the pressure causes a valve switch 65 to move from a closed position in which no compressed air is passed from the supply line 54 to the piston head of the piston 35, to an open position in which compressed air is provided to the piston head. Therefore, when the elevator slips 15 are raised (or are jammed at an intermediate position), the piston 35 remains in its fully extended position, locking the guide plate 24 in its rightmost position. However, when the elevator slips 15 are correctly lowered, the piston 30 is withdrawn within the cylinder 29 and movement of the guide plate 24 is allowed.

It will be appreciated by the person of skill in the art that various modifications may be made to the above described embodiment without departing from the scope of the present invention.

Claims

1. Apparatus for gripping and releasing a tubular, the apparatus comprising:

an elevator having slips for gripping and releasing the tubular;

a spider having slips for gripping and releasing the tubular;

a valve for directly controlling the supply of pressurised fluid to move the spider slips between a gripping position and a release position; and

means for mechanically inhibiting movement of said valve to a position in which the spider slips release the tubular, when the elevator slips are not in a gripping position.

2. Apparatus according to claim 1, wherein said valve for directly controlling the supply of pressurised fluid to move the spider slips is a mechanically operated valve which is operated manually.

3. Apparatus according to claim 2, wherein the valve for controlling the supply of pressurised fluid to the spider slips is operated by a lever.

4. Apparatus according to claim 3, wherein the means for mechanically inhibiting movement of the valve comprises a guide plate through which the lever projects, the guide plate being moveable between a first position the guide plate prevents movement of the lever to open the valve and a second position allows movement of the lever to open the valve, and wherein movement of the guide plate from the first position to the second position is prevented if the elevator slips are not correctly closed.

5. Apparatus according to any one of the preceding claims and comprising sensor means for detecting when the elevator slips are in the correct gripping position, the sensor means being coupled to said means for mechanically inhibiting movement of the spider control valve.

6. Apparatus according to claim 5, wherein the sensor means comprises a piston and cylinder arrangement coupled between the main body and the slips of the elevator.

the piston and cylinder arrangement being coupled hydraulically to said means for mechanically inhibiting movement of the spider control valve.

7. Apparatus according to claim 5, wherein said sensor means comprises a switch which is moved from a first position to a second position when the elevator slips are moved to the correct closed position, and wherein when the switch is in the first position, movement of the guide plate from its first to its second position is prevented, and when the switch is in the second position, movement of the guide plate from its first to its second position is possible.

8. Apparatus according to claim 7, wherein the switch controls the supply of pressurised fluid to a piston and cylinder arrangement, the piston of which locks the guide plate in its first position when the supply of pressurised fluid to the cylinder is prevented, and releases the guide plate when the supply of pressurised fluid to the cylinder is allowed.

9. Apparatus according to claim 8, wherein said switch is arranged to directly open and close a hydraulic or pneumatic circuit.

10. Apparatus according to claim 8, wherein the switch forms part of an electrical circuit which is arranged to open and close a hydraulic or pneumatic circuit.

11. Apparatus according to claim 1, wherein the means for mechanically inhibiting movement of the spider control valve comprises a piston and cylinder arrangement of a hydraulic or pneumatic circuit coupling an elevator control valve to a piston and cylinder arrangement for opening and closing the elevator slips, and wherein the first mentioned piston and cylinder arrangement is located between the piston and cylinder arrangement for moving the slips and the elevator control valve such that a rod of the first mentioned piston and cylinder arrangement is displaced by the flow of fluid in the circuit to inhibit or allow movement of the spider control valve.

12. A method according to claim 3 or 4 and comprising a mechanically operated valve for controlling the supply of pressurised fluid to move the elevator slips between a

gripping position and a release position, the valve being operated by a lever which also projects through said guide plate such that when the guide plate is in its first position, the lever may be moved to open the elevator slips, whilst when the guide plate is in its second position, movement of the lever to open the elevator slips is prevented.

13. Apparatus according to any one of the preceding claims and comprising an additional user operable locking means for preventing accidental movement of the guide plate between the first and second positions.

14. A method of controlling the gripping and releasing of a tubular and comprising mechanically inhibiting movement of control means for directly controlling the flow of fluid to raise and lower a set of spider slips, when a set of slips of an elevator are not correctly gripping the tubular, such that the spider slips cannot be moved from a gripping to a release position.

15. A method of gripping and releasing a tubular, the method comprising the steps of:

gripping the tubular with a spider;

actuating a set of slips of an elevator in order to move the slips from a position in which the tubular is not gripped by the slips to a position in which the tubular is gripped by the spider;

in the event that actuation of the elevator slips does not cause the slips to move into the gripping position, mechanically inhibiting movement of a valve directly controlling the movement of a set of spider slips such that the spider slips cannot be moved from a gripping to a release position; and

in the event that the elevator slips achieve the correct gripping position, allowing said valve to be operated to move the spider slips from the gripping to the release position.

Amendments to the claims have been filed as follows

Claims

1. Apparatus for gripping and releasing a tubular, the apparatus comprising:

an elevator having slips for gripping and releasing the tubular;

a spider having slips for gripping and releasing the tubular;

a valve for directly controlling a supply of pressurised fluid to move the spider slips between a gripping position and a release position; and

means for mechanically inhibiting movement of said valve to a position in which the spider slips release the tubular, when the elevator slips are not in a gripping position.

2. Apparatus according to claim 1, wherein said valve for directly controlling the supply of pressurised fluid to move the spider slips is a mechanically operated valve which is operated manually.

3. Apparatus according to claim 2, wherein the valve for controlling the supply of pressurised fluid to the spider slips is operated by a lever.

4. Apparatus according to claim 3, wherein the means for mechanically inhibiting movement of the valve comprises a guide plate through which the lever projects, the guide plate being moveable between a first position in which the guide plate prevents movement of the lever to open the valve and a second position in which the guide plate allows movement of the lever to open the valve, and wherein movement of the guide plate from the first position to the second position is prevented if the elevator slips are not correctly closed.

5. Apparatus according to claim 4 and comprising an additional user operable locking means for preventing accidental movement of the guide plate between the first and second positions.

6. Apparatus according to any one of the preceding claims and comprising sensor means for detecting when the elevator slips are in the correct gripping position, the

sensor means being coupled to said means for mechanically inhibiting movement of the spider control valve.

7. Apparatus according to claim 6, wherein the sensor means comprises a piston and cylinder arrangement coupled between the main body and the slips of the elevator, the piston and cylinder arrangement being coupled hydraulically to said means for mechanically inhibiting movement of the spider control valve.

8. Apparatus according to claim 6 when appended to claim 4, wherein said sensor means comprises a switch which is moved from a first position to a second position when the elevator slips are moved to the correct closed position, and wherein when the switch is in the first position, movement of the guide plate from its first to its second position is prevented, and when the switch is in the second position, movement of the guide plate from its first to its second position is possible.

9. Apparatus according to claim 8, wherein the switch controls the supply of pressurised fluid to a piston and cylinder arrangement, the piston of which locks the guide plate in its first position when the supply of pressurised fluid to the cylinder is prevented, and releases the guide plate when the supply of pressurised fluid to the cylinder is allowed.

10. Apparatus according to claim 9, wherein said switch is arranged to directly open and close a hydraulic or pneumatic circuit.

11. Apparatus according to claim 9, wherein the switch forms part of an electrical circuit which is arranged to open and close a hydraulic or pneumatic circuit.

12. Apparatus according to claim 1, wherein the means for mechanically inhibiting movement of the spider control valve comprises a piston and cylinder arrangement of a hydraulic or pneumatic circuit coupling an elevator control valve to a piston and cylinder arrangement for opening and closing the elevator slips, and wherein the first mentioned piston and cylinder arrangement is located between the piston and cylinder arrangement for moving the slips and the elevator control valve such that a rod of the

first mentioned piston and cylinder arrangement is displaced by the flow of fluid in the circuit to inhibit or allow movement of the spider control valve.

13. Apparatus according to claim 4 and comprising a mechanically operated valve for controlling the supply of pressurised fluid to move the elevator slips between a gripping position and a release position, the valve being operated by a lever which also projects through said guide plate such that when the guide plate is in its first position, the lever may be moved to open the elevator slips, whilst when the guide plate is in its second position, movement of the lever to open the elevator slips is prevented.

14. A method of controlling the gripping and releasing of a tubular, comprising mechanically inhibiting movement of control means for directly controlling a flow of fluid to raise and lower a set of spider slips, when a set of slips of an elevator are not correctly gripping the tubular, such that the spider slips cannot be moved from a gripping to a release position.

15. A method of gripping and releasing a tubular, the method comprising the steps of:

gripping the tubular with a spider;

actuating a set of slips of an elevator in order to move the slips from a position in which the tubular is not gripped by the elevator slips to a position in which the tubular is gripped by the elevator slips;

in the event that actuation of the elevator slips does not cause the slips to move into the gripping position, mechanically inhibiting movement of a valve directly controlling the movement of a set of spider slips such that the spider slips cannot be moved from a gripping to a release position; and

in the event that the elevator slips achieve the correct gripping position, allowing said valve to be operated to move the spider slips from the gripping to the release position.

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Application No: GB 0026997.7
Claims searched: 1 - 15
Examiner: Dean Lacey
Date of search: 12 December 2000

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.R): E1F: FGR
Int Cl (Ed.7): E21B: 19/07, 19/10
Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0887510 A1	(Weatherford)	
A	EP 0589823 A1	(Varco)	
A	WO 98/31914 A1	(Castille et al.) See fig. A and page 13 line 15 - page 15 line 15	
A	WO 94/04788 A1	(Weatherford)	
A	US 4676312 A	(Mosing) See fig. 4, col. 4 line 26 - col. 5 line 12 and col. 5 lines 42 - 57	

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